The Human Controller

Class 14: Future of Human-Machine Interaction - General Discussion

How do we combine the best of human and intelligent systems?

"Adapt the device to the human, not the human to the device!"

Teacher:

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- BioMechanical Engineering, Delft University of Technology, The Netherlands

High-level goals of this Class - recap

Learn about:

1. **human (manual) control behavior**
   From perception to action

2. **how to quantify human capabilities and limitations**

3. **how to use this knowledge in system design**

Goals of this Class

Give the poor teacher some rest…

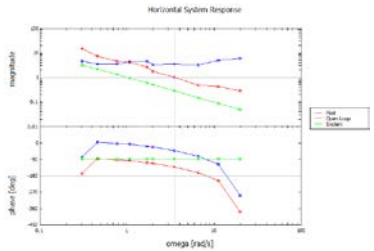
1. **YOU tell me what you have learned for each class**
2. **Join in a discussion..!**

What did you learn

During the class:

-
-
-

Practical Assignments 1 - 3



What have we learned about humans interacting with machines?

- **Interaction behaviour is hard to model completely**
  - simple models work for some tasks, not for others
- **Balance between control effort and performance**
  - Different metrics are possible (can be confusing!)
- **Interaction behaviour depends on:**
  - Different system dynamics
  - Different task properties (pursuit/compensatory; perturbation frequency/amplitude)

  And can be influenced by selection / design
  - Subjects (training/selection); Control interface (mouse, input gains, master device)
  - Natural / enhanced feedback

Examples of Exam Questions

Be brief and to the point
Motivate your answers!

Tele-Operation

During telemanipulation it is important for the human to have good haptic feedback and a good situational awareness. Both haptic transparency and haptic guidance have shown to be useful while performing manipulation tasks. When presented with a haptic guidance system, humans will arguably start to rely on these guidance forces, and will have less need to feel high-quality natural feedback.

- Give two important reasons to still include high-quality transparency while haptic guidance is present.

Tele-Operation

Quadrotors (see figure) are a type of low-cost remote-controlled rotorcraft, that are known for their relatively easy control, compared to helicopters. Commonly - in order to facilitate the control – the quadrotors are automatically stabilized in the horizontal plane. Quadrotors are used in many different application fields, for example to make smooth movement shots for movies. However it still requires much training for the operator to get a good a sense of ‘telepresence’.

- Name three important cues that the human operator missing, that he/she would experience if he/she would be present inside the vehicle.

Evaluation

Consider a case where a ‘birds-eye’ shot needs to be made: with the camera making a smooth flight over terrain, at a constant height close to the ground, navigating between trees and rocks and ending up at a target: the movie hero. Suppose you get only one attempt to make the right smooth and steady shot, and therefore need to select and train the right person for the job. You make a simplified computer simulation of the task. Note that the human-machine interface for the operator consists of a screen which shows the simulated camera view, and a joystick with which the operator can command velocity in the horizontal plane.

- Describe four metrics that can be easily measured / constructed that would indicate difference in operators skill. .

Evaluation

- Explain why it is important to quantify the effort of a human controller in addition to quantifying performance. Relate your explanation to the concept of satisficing control.

Adaptation for the Human Controller:

Which class was best, which the worst? What worked, what didn't?

Any feedback / comments to help improve the course: please mail me

Also, please take the time to fill in the centralized evaluation sheets for the course

So…. how to design HMI?

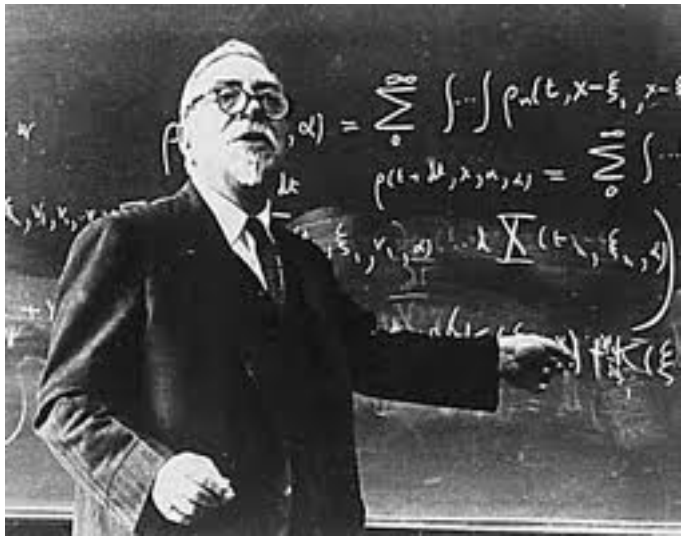
We aimed to give you design guidelines and tools to predict the effects of a human-machine interface design

Is it possible to predict such effects?

- Yes, but for modeling human-machine interaction we need to know:
  - Controlled system
  - Control device
  - Naturally occurring cues
  - Additional information display
  - Task(s)
  - Disturbances
  - Human operator characteristics

We need to model the human, understand and predict behaviour and adaptation

Norbert Wiener (1894 – 1964)



Norbert Wiener (1894-1964)

"The best model of the cat?"

Published the book Cybernetics: Control and Communication in Man and Machine (1948)

Changing reality: what is reality?

Rene Descartes (1596-1650)
“Cogito ergo sum”

postulated a dualism between **res extensa**, objects located outside the mind, and **res cogitans**, objects located within the mind.

The Cartesian view—that there are clearly separable mental and physical domains — pervades Western thinking today, including cognitive science as well as physical science and engineering. There are objective measures and subjective measures, and we know which is which.

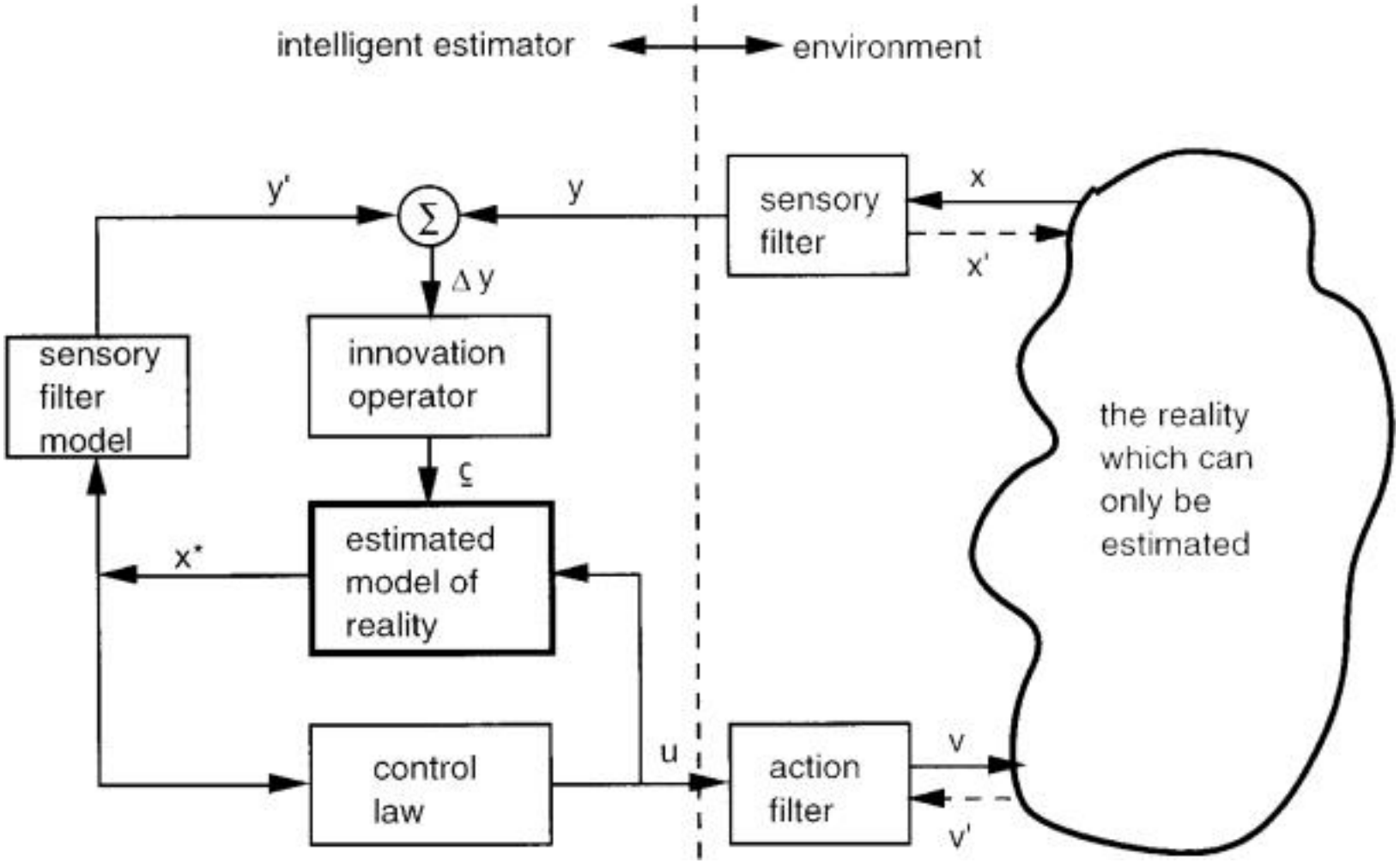
Changing reality: what is reality?

Martin Heidegger (1889-1976)

all meaning, hence all reality, is conditioned by interpretation, including the beliefs, language, and practices of the interpreter.

Normal "being," in the Heideggerian view, means complete involvement in **a dynamic interaction**—in which subject and object are not separable—and only by stepping back and disconnecting from that involvement can a person perceive the elements of the situation.

Observing reality: what is reality?
Are we Kálmán filters?



The future of human-machine interaction?

Where are we headed? What trends do you see?

- Controlling more and more complex machines
  - Closing ‘open systems’
- Repairing / extending physical & mental capabilities
- Creating adaptable, self-learning machines

"Machines will do what we ask them to do and not what what we ought to ask them to do." Norbert Wiener, 1949, published in John Markoff, NYTimes May 21, 2013

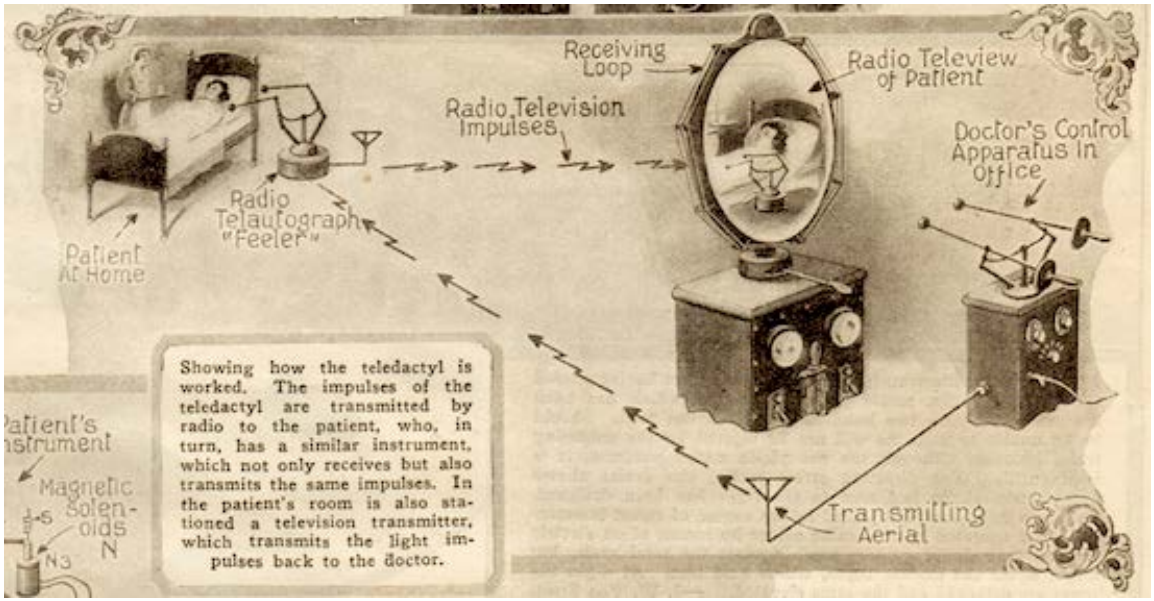
Past Visions of the Future

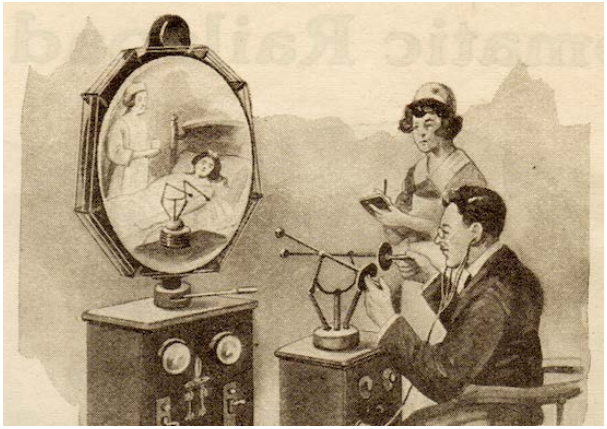
Visions of 1993 (predicted in 1893)

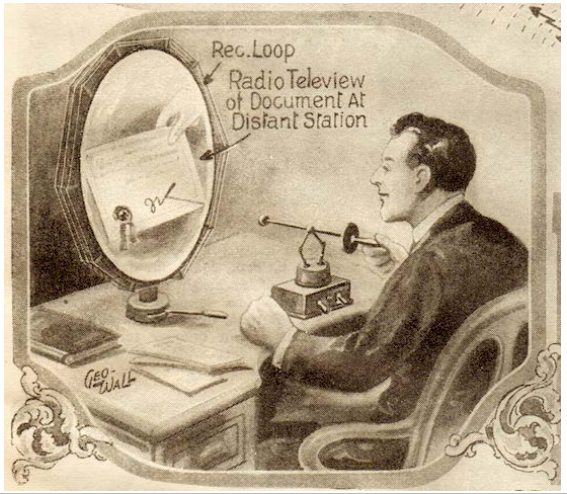
The March 25, 1893 *Newark Daily Advocate* (Newark, OH) ran predictions of what the world of 1993 would look like. Excerpts from each of the four journalists (George Alfred Townson, Kate Field, Nym Crinkle, and John Swinton) appear below. The entire article is embedded below, or you can read it **here.**

- The encyclopedic man, who makes a show of knowing all things, will give way to the specialist, who makes an effort to know one thing and know it well.
- Humans will have more leisure to think. The present rate of headlong material activity cannot be kept up for another hundred years.
- Every person of fairly good education and of restless mind writes a book. As a rule, it is a superficial book, but it swells the bulk and it indicated the cerebral unrest that is trying to express itself. We have arrived at a condition in which more books are printed than the world can read. This is true not only of books that are not worth reading, but it is true of the books that are. (...) Everybody wants to say something. But it is slowly growing upon the world that everybody has not got something to say.

Future of manipulation?

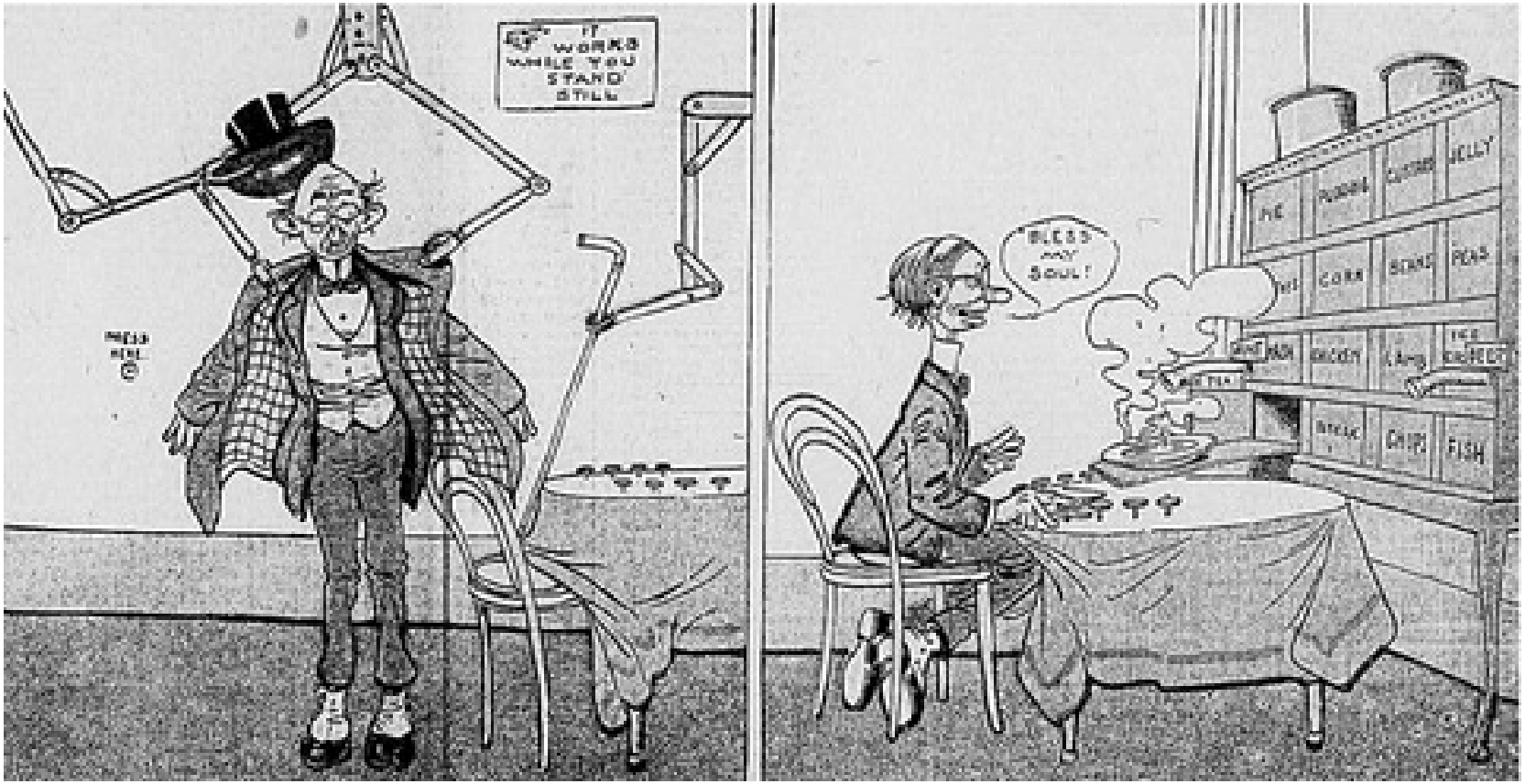






Future of Food - 1903

This *Professor Jyblitts cartoon from 1903 imagines an "automatic luncheon"*

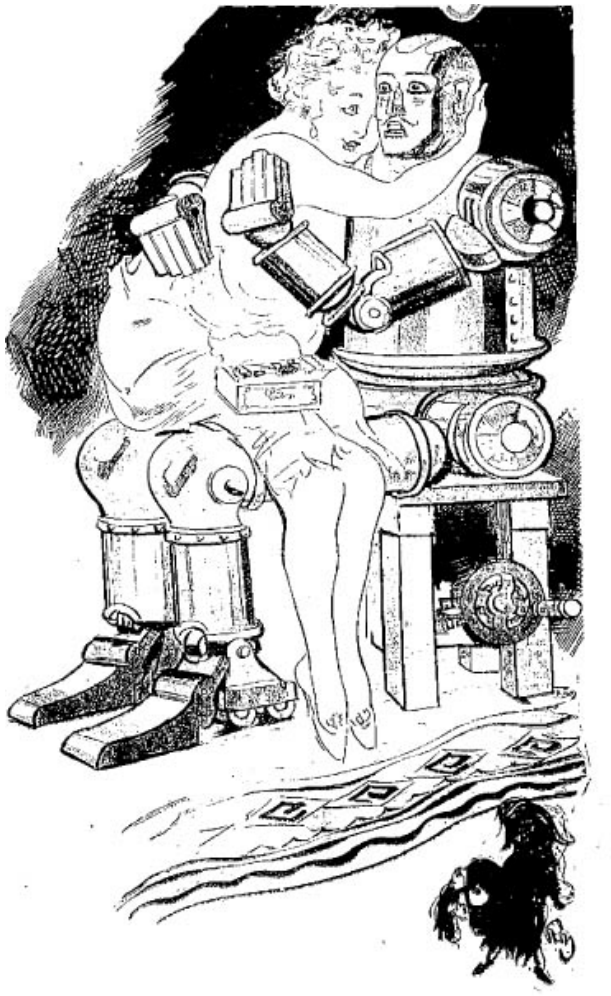


Future of Food - now

Yummy

Future of ‘Companionship’ - 1928

The July 1, 1928 *San Antonio Light* (San Antonio, TX) ran a syndicated story titled, "Romantic Old Maids Can Hear the Words of Love They Long For."



Future of the Military - 1935

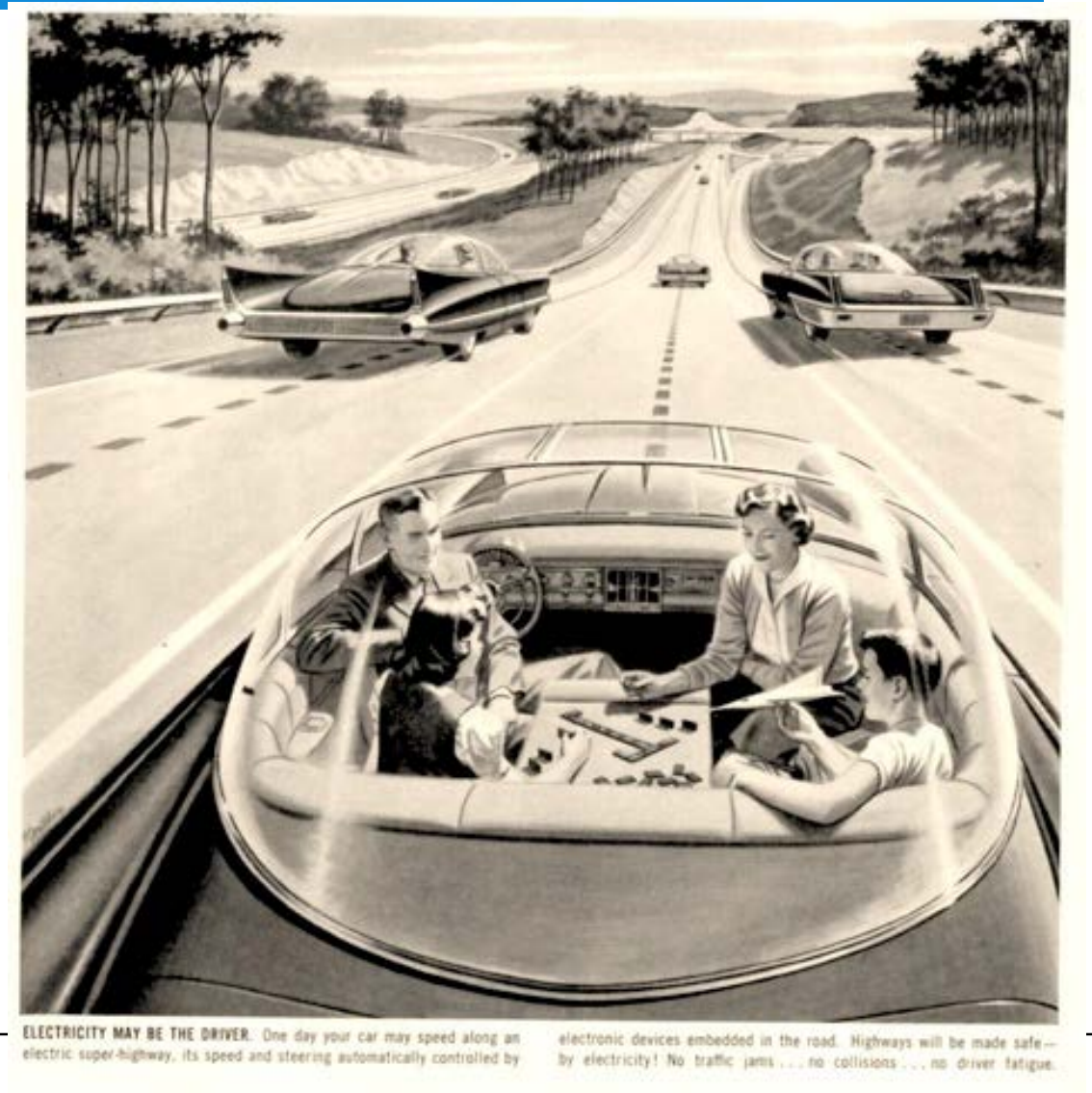
This article from the July 28, 1935 *San Antonio Light* (San Antonio, TX) features illustrations from artist Erik Nitsche depicting robots with machine guns for heads, robot scouts with movie camera faces

Future of Communication - 1957

1957: Ad from Hughes Aircraft Companyy:
Face-to-face telephone call

Future of Driving - 1957

1957: Ad from Electricity Company



Future of Teaching - 1958

The May 5, 1958 edition of Arthur Radebaugh's Sunday comic, *Closer Than We Think*, showed off the high-tech school of tomorrow.

PUSH-BUTTON EDUCATION Tomorrow's schools will be more crowded; teachers will be correspondingly fewer. Plans for a push-button school have already been proposed by Dr. Simon Ramo, science faculty member at California Institute of Technology. Teaching would be by means of sound movies and mechanical tabulating machines. Pupils would record attendance and answer questions by pushing buttons. Special machines would be "geared" for each individual student so he could advance as rapidly as his abilities warranted. Progress records, also kept by machine, would be periodically reviewed by skilled teachers, and personal help would be available when necessary.

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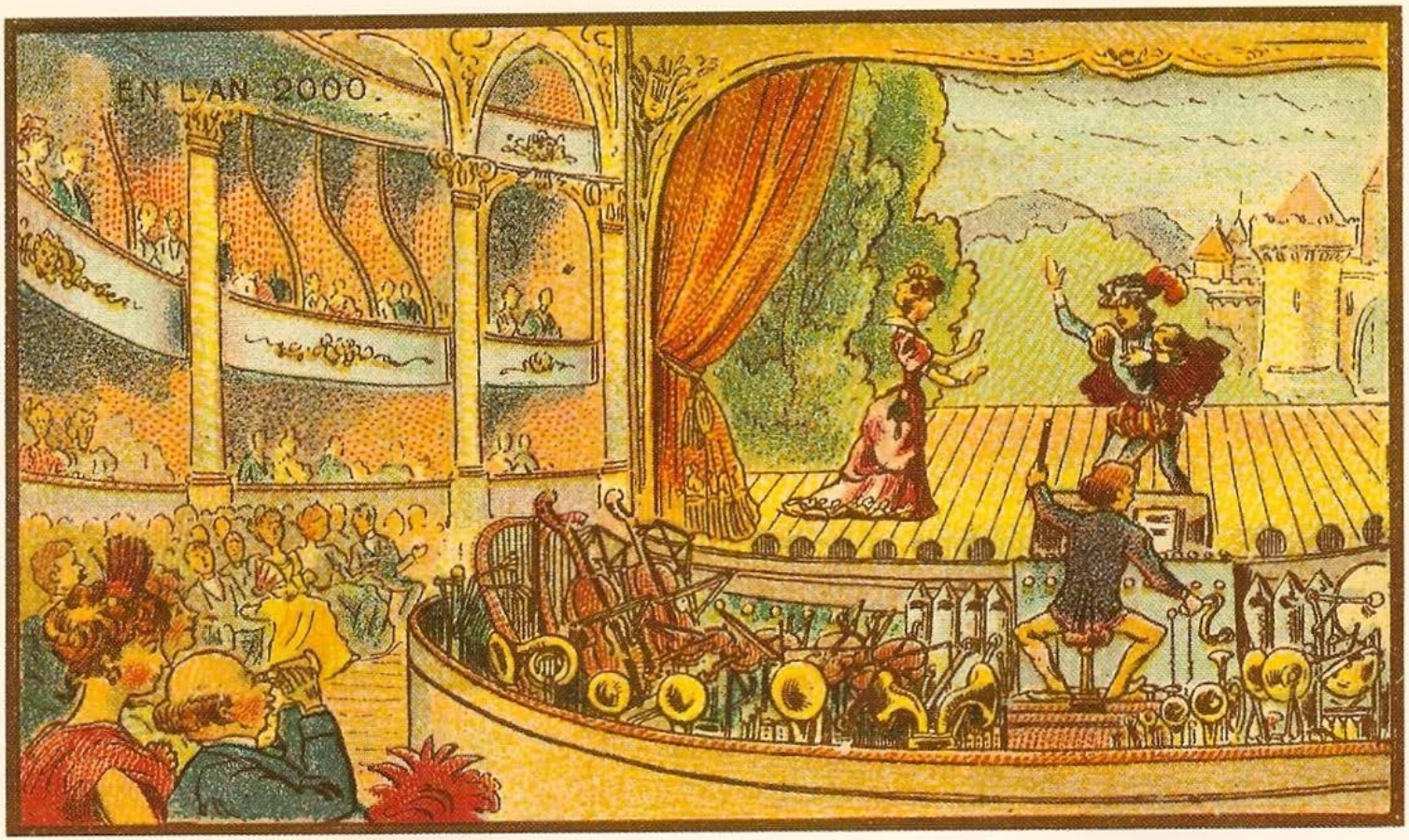
Future of Music?



A Well-Trained Orchestra

Future of Music?

Future of Music?

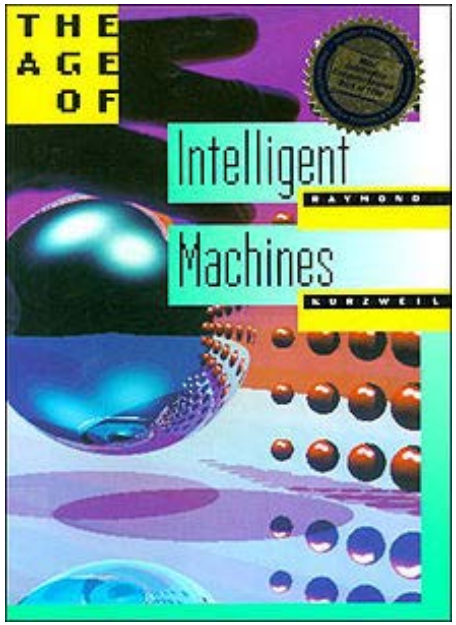
Computers: They are useless. They can only give you answers. — Pablo Picasso, in In Search of Genius, 1982, by William Fifield, p. 140, and p. 40.

Recent Visions of the Future

Any sufficiently advanced technology is indistinguishable from Nature. — Karl Schroeder, Charlie's Diary, August 12, 2011

The Age of Intelligent Machines (1990)

Ray Kurzweil
an American author, scientist, inventor, futurist, and director of engineering at Google.

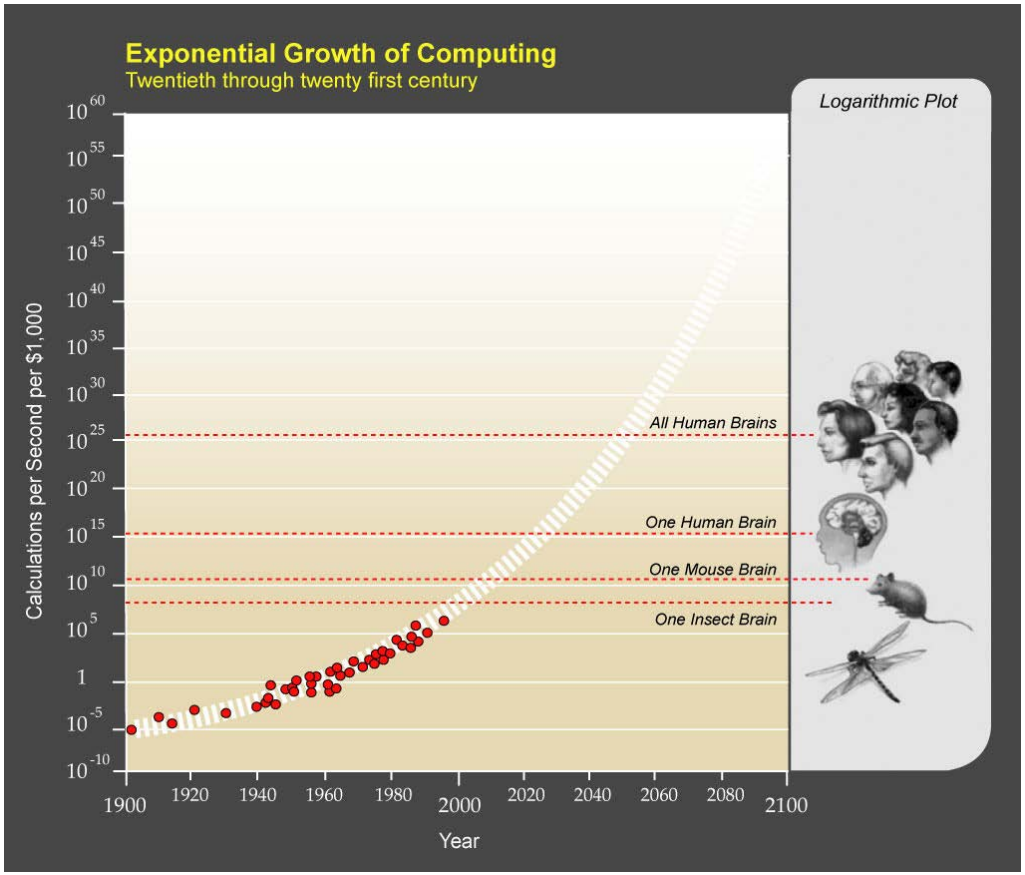


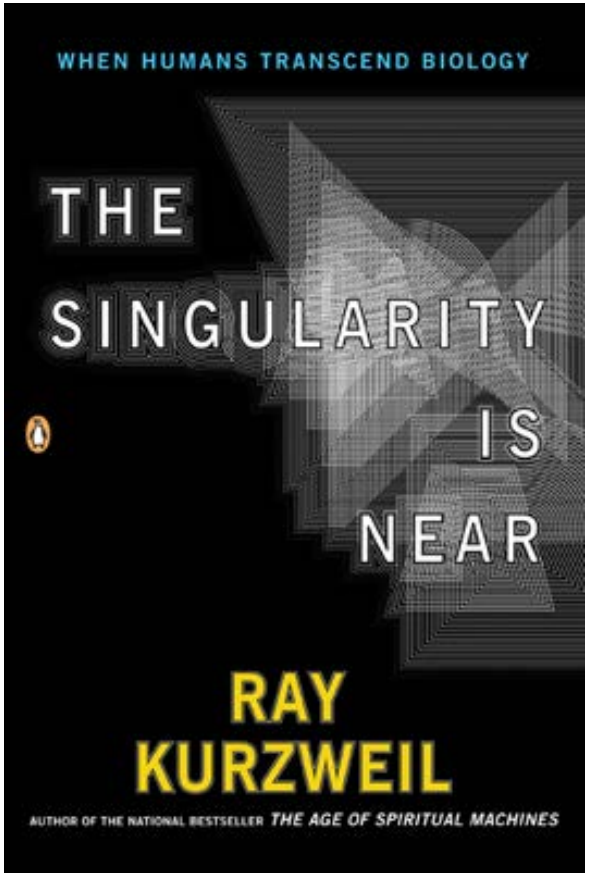
Human enhancement
Handicapped individuals will be greatly assisted by the advancing technology with reading machines, hearing machines, and robotic exoskeletons.

Singularity (2045)
occurs as artificial intelligences surpass human beings as the smartest and most capable life forms on the Earth. Technological development is taken over by the machines, who can think, act and communicate so quickly that normal humans cannot even comprehend what is going on

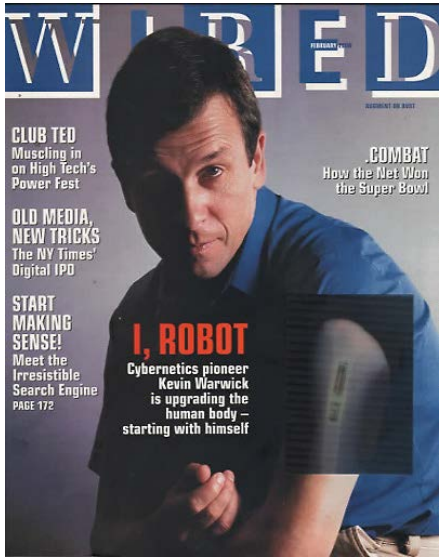
The Singularity is near (2005)

Ray Kurzweil
an American author, scientist, inventor, futurist, and director of engineering at Google.





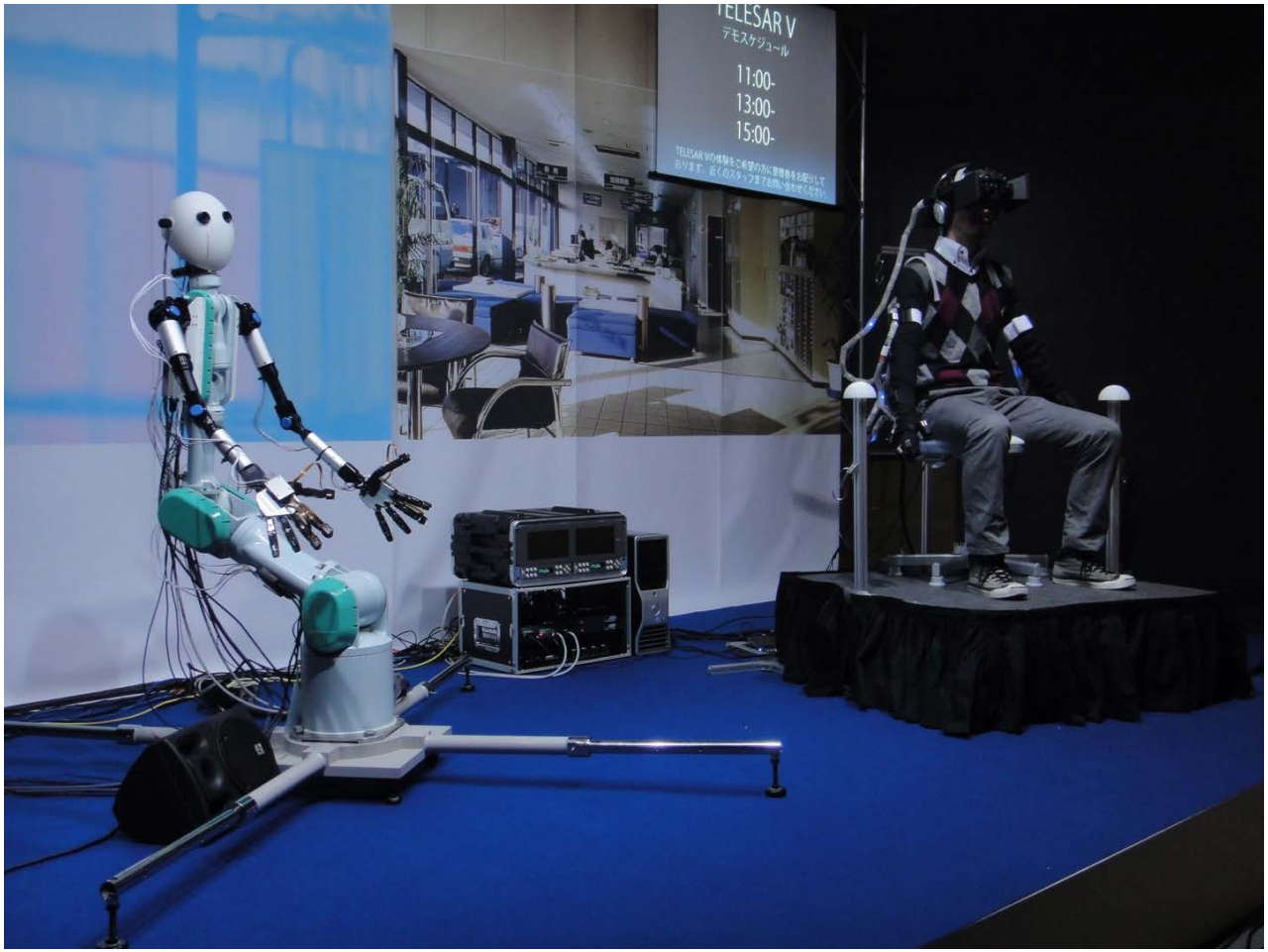
Cybernetic Body Extensions



Kevin Warwick https://www.youtube.com/watch?v=Z8HeFNJjuj0

Claudia Mitchell with her "bionic arm."
Photo courtesy AP Photo/Caleb Jones

Tele-presence / Tele-existence



http://tachilab.org/modules/projects/telesar5.html

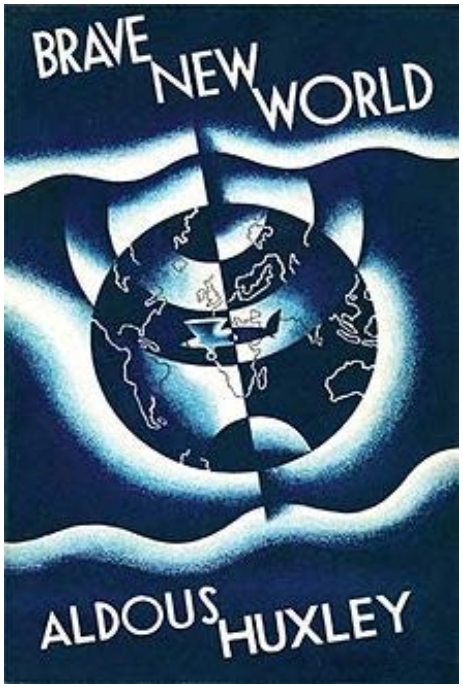
Immersive virtual reality and teleoperator systems provide the technical means for instantaneously ‘transferring’ a person into a different place.

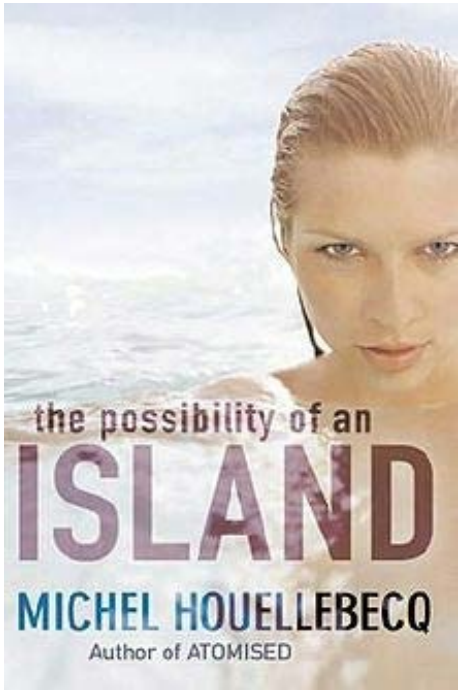
Extending Mind over another Body?

Avatar

Beyond Humanity?

Transhumanist thinkers study the potential benefits and dangers of emerging technologies that could overcome fundamental human limitations, as well as the ethics of developing and using such technologies.
They speculate that human beings may eventually be able to transform themselves into beings with such greatly expanded abilities as to merit the label "posthuman"

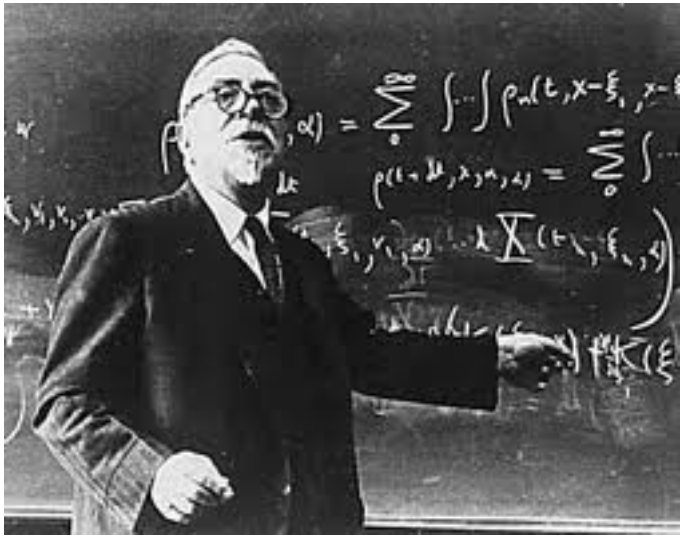




Norbert Wiener about the Future

Norbert Wiener (1894-1964)

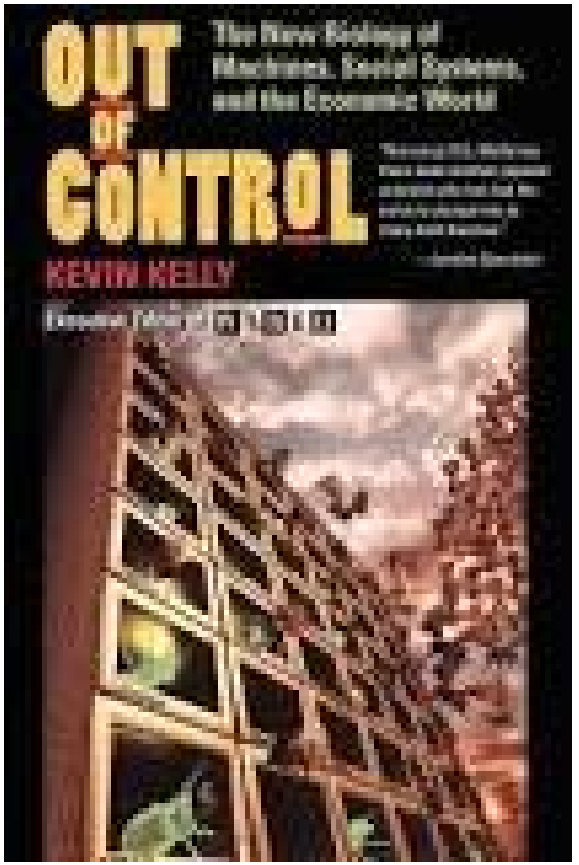
"The dominance of the machine presupposes a society in the last stages of increasing entropy, where probability is negligible and where the statistical differences among individuals are nil.
Fortunately we have not yet reached such a state."



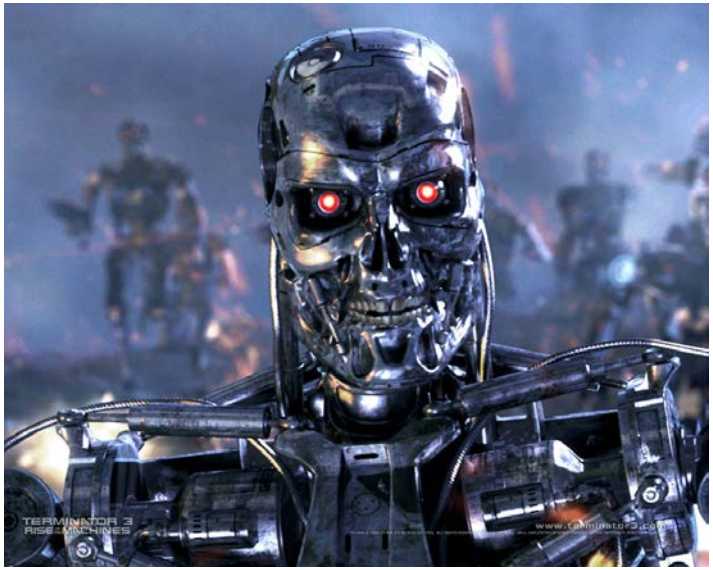
Kevin Kelly – Out of Control (1994)

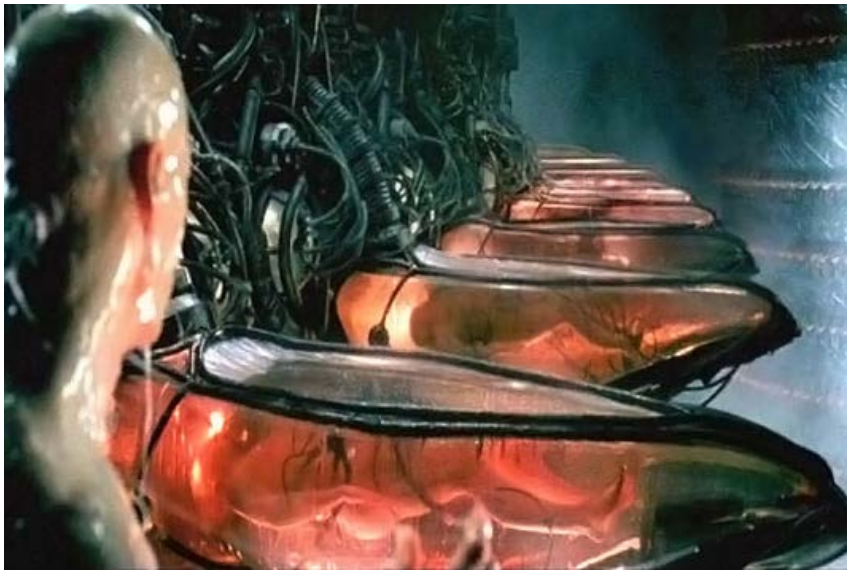
We have to 'let go', in order to create more possibilities in our world

The future of control is 'co-control'



Creating Self-adapting Machines?





Aldous Huxley vs George Orwell
– 'Brave new world' (1936) vs '1984' (1948)

Both said our world would be one of slavery, but for different reasons….

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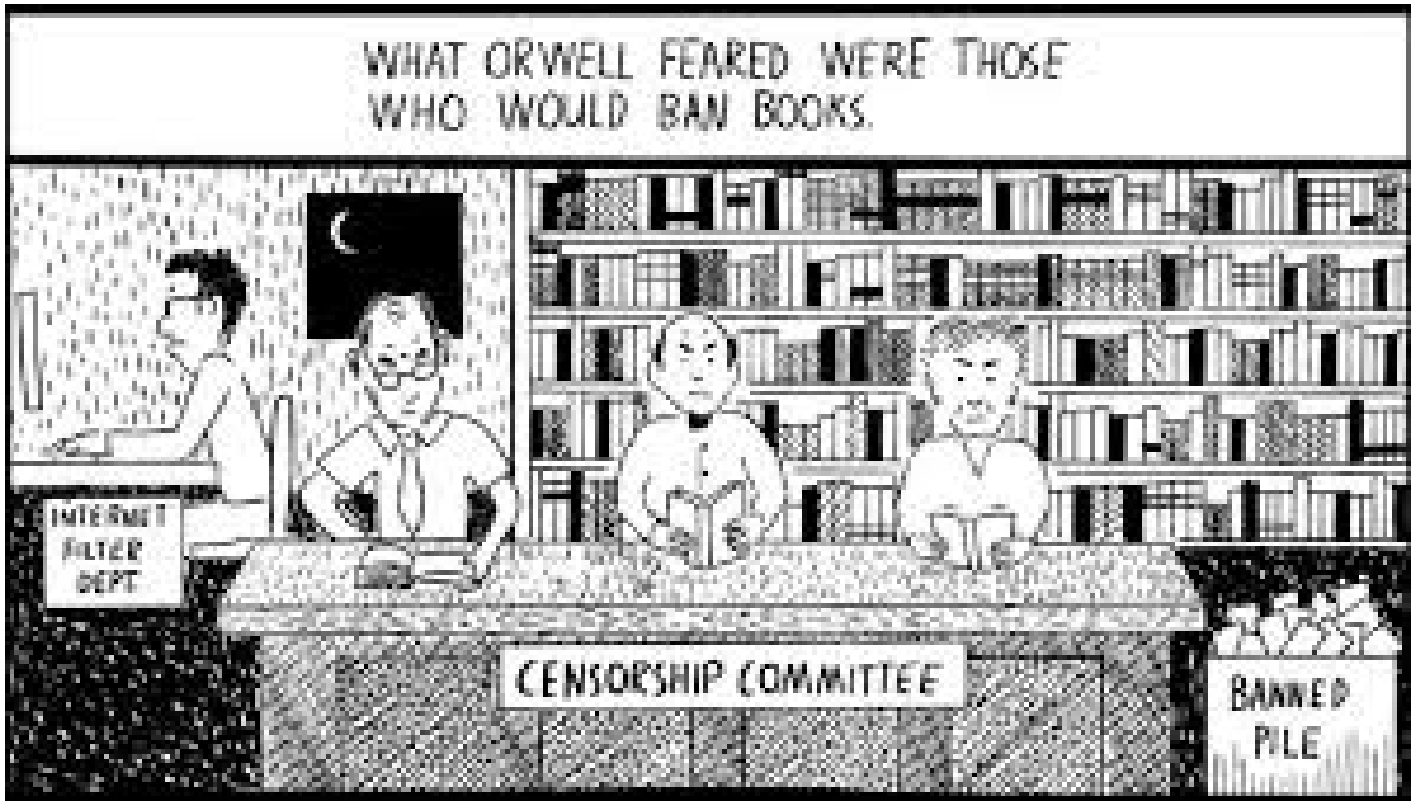

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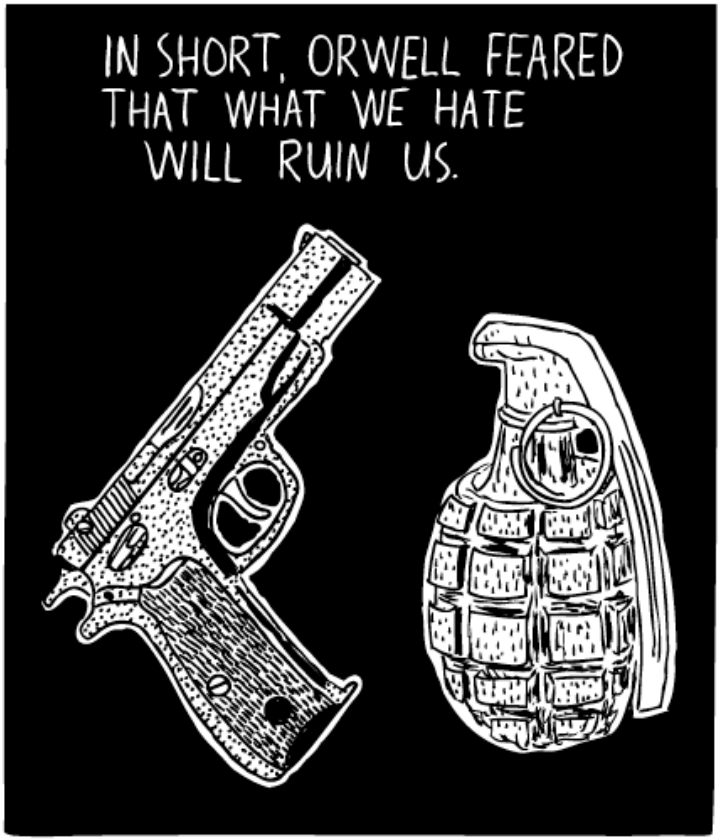

What should be the future ….
….. according to you?

What drives the technology we design?

What should be the role of the human?

And what is your responsibility, as an engineer?